

ADS-B Primer

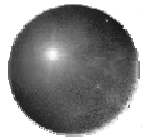
An Overview of Emerging Surveillance Technology

By Jack Van Zandt
05/27/03



What is ADS-B?

- ⊗ Automatic Dependant Surveillance - Broadcast
- ⊗ Surveillance technology that transmits GPS based position and other aircraft or vehicle information once per Second.
 - ⊗ Aircraft/Vehicle ID, GPS position, Altitude, Climb/Descent profile, Speed, etc.
 - ⊗ International (ICAO) Cat 33 standard defines the information sent and protocols.
 - Eurocontrol protocol.
 - ⊗ Requires special equipage in aircraft.
 - Equipage levels are increasing, especially in ASO, ASW, and AAL.

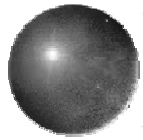


How is ADS-B Information Transmitted?

Two “links” or frequencies are approved.



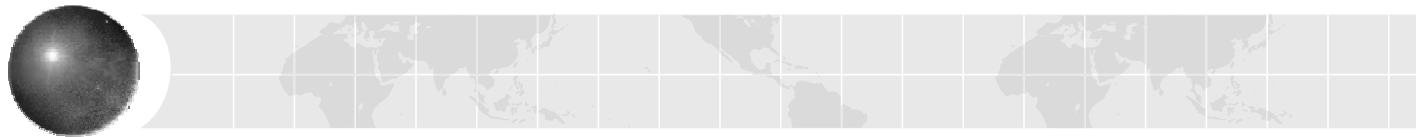
- 1090 MHz or Mode S “extended squitter”
 - Primarily used for air carrier and commercial aircraft (e.g. UPS)
- UAT (978 MHz)
 - Used for typical GA aircraft
 - Surface vehicles
 - DOT/DOD coordination



How is ADS-B Received?



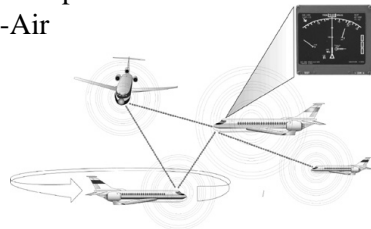
- ADS-B information is transmitted continuously
- Line of site receivers capable of receiving 1090 or UAT can receive and make data available for processing in:
 - Aircraft
 - Vehicles (crash vehicles, snow plows, etc)
 - FAA systems (ARTS, Micro EARTS, STARS)
 - Non-FAA Systems (Embry Riddle, UPS, etc.)
- Systems provide a radar-like display of data.



How can ADS-B be used?

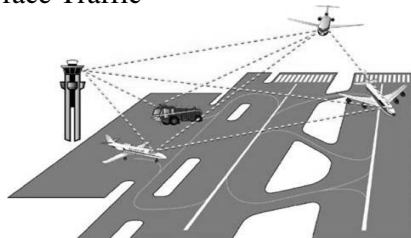
Air-to-Air

- Improved Separation Standards
- Improved Low-Visibility Approaches
- Enhanced See and Avoid
- Enhanced Operations for En Route Air-to-Air



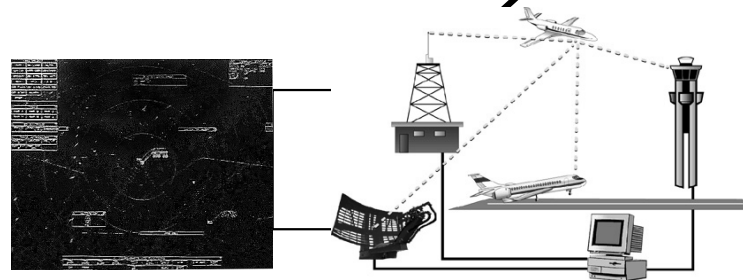
Ground-to-Ground

- Improved Navigation on Taxiways
- Enhanced Controller Management of Surface Traffic



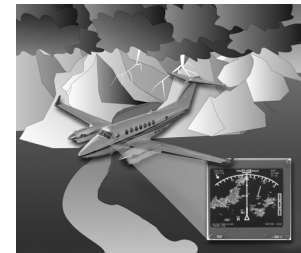
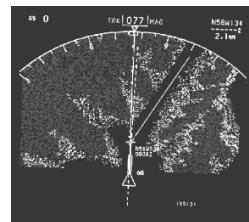
Air-to-Ground

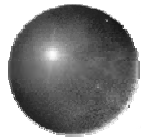
- Surveillance Coverage in Non-Radar ~~Airspace~~



Ground-to-Air & Self-Contained

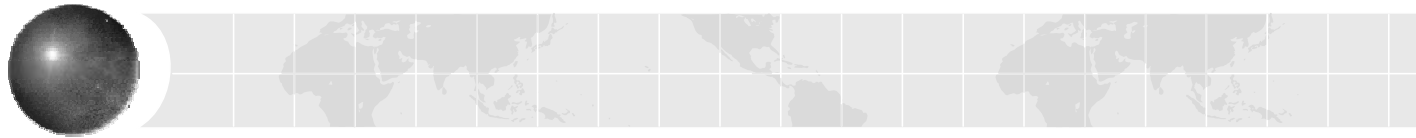
- Weather and SSR Traffic to the Cockpit
- Affordable Reduction of Controlled Flight into Terrain (CFIT)





Integration in FAA systems

- ⊕ ADS-B capability exists in the Anchorage Micro-EARTS system as a supplemental surveillance source.
 - ⊠ Certified for 5nm “radar like” separation.
 - ⊠ Successful in Bethel and now being installed in the Juneau area.
- ⊕ ADS-B is a baseline input for ASDE-X/3X
- ⊕ ARTS IIIE and STARS are being updated to accept ADS-B as an additional surveillance source.
 - ⊠ SDF is test site for ARTS IIIE
 - ⊠ MEM is test site for STARS & PRM Like capability



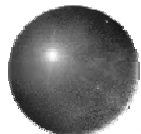
What is CDTI?

- ✦ Cockpit Display of Traffic Information
 - ✦ Radar like display for ADS-B traffic
 - ✦ Being developed by several vendors
 - ✦ Variety of Capabilities including
 - Consolidates ADS-B traffic, terrain, weather, own-ship information and location, and other products.
 - Allows pilots to determine distance to traffic.
 - Includes “moving map” display for airport maps now under development.
 - ✦ UPS Technologies is most widely used at this time but other vendors are building systems with similar capabilities.



AT2000





Ground Speed of the “ownship” aircraft.

The CDTI display provides detailed information on a selected aircraft along with normal “radar like” displays of other traffic.

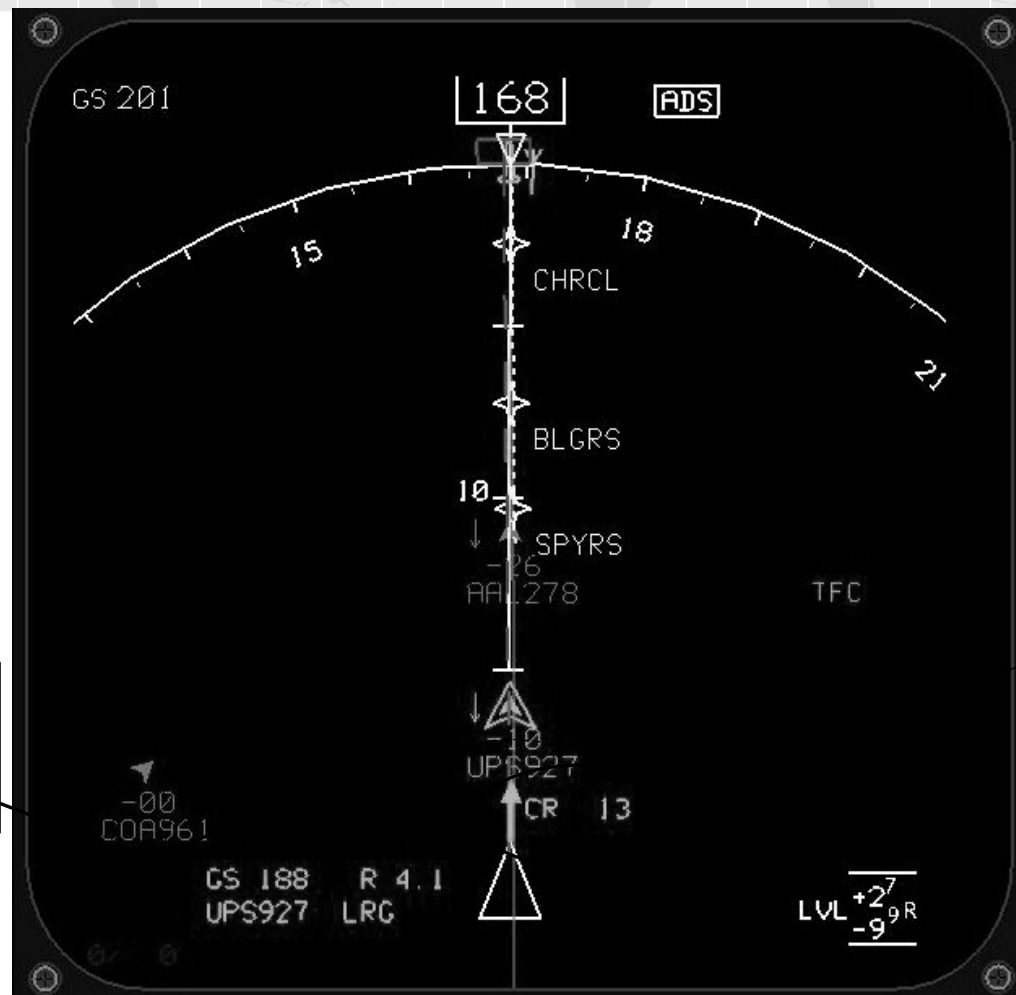
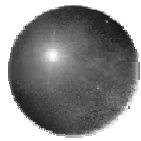
Here, we see that the “selected” aircraft is UPS350, a Large aircraft with a Ground Speed of 255 knots and a range of 14NM. This is updated every second.

The data readout shows the aircraft 4500 feet above the “ownship” altitude and climbing.



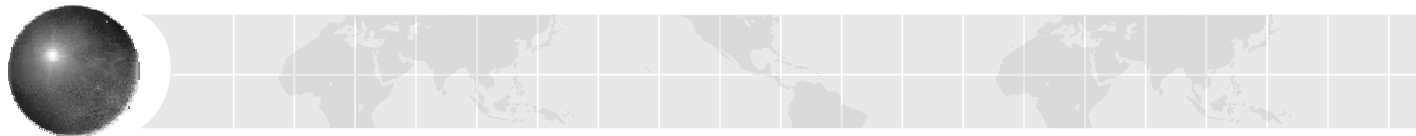
This is the closure rate between the two aircraft. In this case, the lead aircraft is pulling away

This arc can be set for any distance. Once an aircraft enters the area defined by the arc, the pilot receives an audible warning. The arc is set at 12NM on this display.



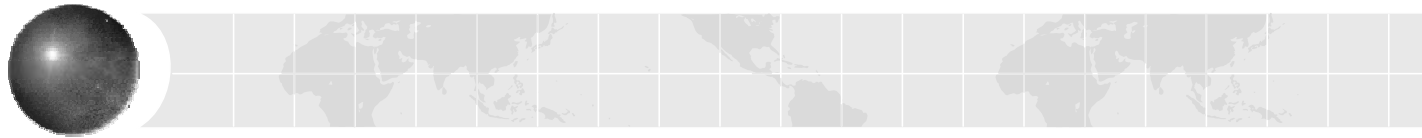
This is another example with a following distance of 4.1 NM.

Closure Rate is + 13 knots.



Other CDTI Indications





Impact on Operations

- ⊕ Not limited to SDF

- ⊞ Whenever two ADS-B equipped aircraft on the same link are in range of each other, they will be displayed on the CDTI.
 - Not limited to SDF area but worldwide.

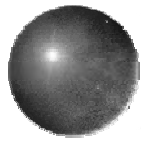
- ⊕ Improved accuracy

- ⊞ CDTI displays digital distances on selected aircraft to 1/10 mile.



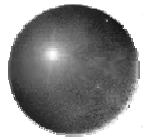
Impact on Operations (cont.)

- ⊕ UPS is briefing pilots to use equipment for locating aircraft but do not refer to it in voice communications.
- ⊕ Controllers will not use phraseology until coordination and training is complete.



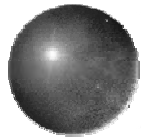
Traffic Information Service Broadcast (TIS-B)

- ⊗ ADS-B does not display all ATC information available.
 - ⊗ Separate Links
 - ⊗ FAA radar information
- ⊗ TIS-B consolidates traffic information available for broadcast to aircraft not already displaying the traffic.
 - ⊗ ADS-B UAT/1090
 - ⊗ ASDE-X, ASR
- ⊗ Aircraft display will present ADS-B and TIS-B traffic



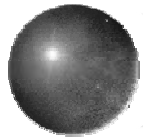
Implementation Plans

- ⊕ UPS to install CDTI equipment in 107 aircraft by 10/03
 - ⊠ Certified for “Enhanced Visual Acquisition”
 - ⊠ Will be used by pilots flying into SDF
 - Pilots will follow normal procedures but use CDTI to assist in locating traffic.
- ⊕ Is available to pilots nationwide when equipped aircraft are in vicinity of each other.



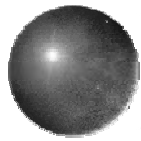
Data Collection

- ⊗ UPS/FAA agreement requires data collection.
 - ⊗ FAA paid to install avionics on UPS aircraft
 - ⊗ UPS required to show impact.
 - ⊗ If positive, UPS refunds FAA
 - ⊗ Decision based on data collection
- ⊗ AND-510 facilitating effort to define the metrics and guidelines for data collection.
 - ⊗ NATCA part of team
 - ⊗ Initial metrics discussion planned within the next month.



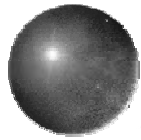
Traffic Call Phraseology

- ⊕ UPS/FAA (SDF) to test “Traffic Call” phraseology
 - ⊕ Incorporating Call Sign into the traffic call.
 - ⊕ Waiver issued for optional use of phraseology.
 - ⊕ Next steps
 - HQ finalize phraseology ~7/03
 - Modify ARTS to put indicator in FDB for CDTI equipage. ~7/03
 - Controller Training ~07-08/03
 - Implementation ~08-09/03



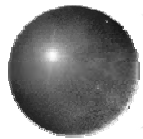
CDTI Enhance Flight Rules (CEFR) Approach

- ⊕ Allows Visual Approaches to continue when pilots lose sight of the “aircraft to follow” visually but have the aircraft position on the CDTI display.
 - ⊞ Undergoing testing in the Mitre lab
 - Good response from pilots
 - Controllers will use normal Visual Approach phraseology/procedures.
 - ⊞ Next steps:
 - Refine Conops 9/03
 - High fidelity simulations / Flight test Decision / OSA 4/04
 - STC @ SDF / In Service Evaluation - 10/04



ERAU ADS-B

- ✦ MOA with ERAU Prescott signed in January 2003
 - ✦ ERAU to procure, install, and maintain ADS-B avionics
 - ✦ FAA to procure, install, and maintain ADS-B ground infrastructure
- ✦ ERAU coverage EXPANDED TO BOTH CAMPUSES
 - ✦ Daytona and Prescott
- ✦ ERAU ordered 104 UPSAT MX-20 ADS-B ship sets on 4/01/03 (for both campuses)
- ✦ ERAU will have fully installed systems (airborne and ground display) for January '04 class.
- ✦ ERAU will use the UAT link.



East Coast ADS-B Deployment

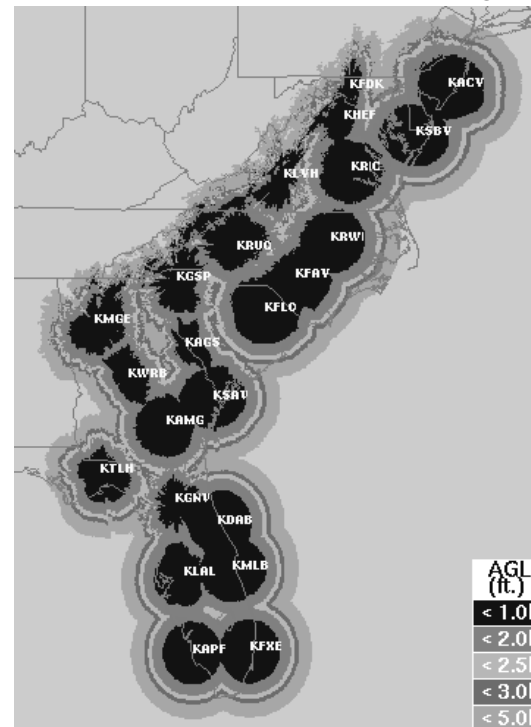
✦ Objective

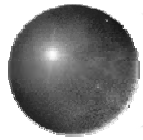
- ✦ Provide ADS-B and broadcast services along U.S. east coast from Florida to New Jersey

✦ Goal

- ✦ Encourage avionics development by industry and equipage by general aviation owners/pilots

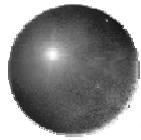
Notional ADS-B Coverage





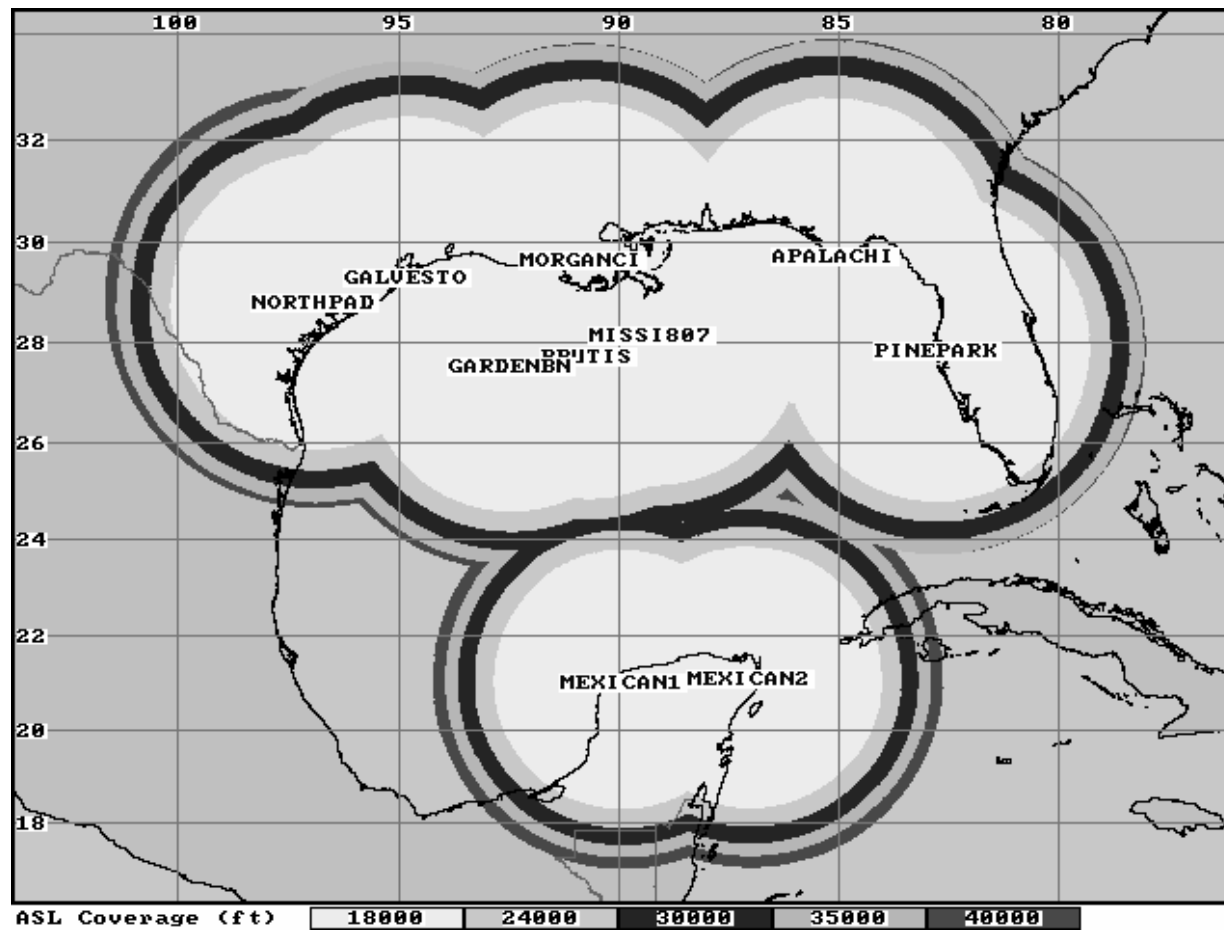
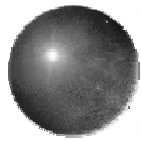
East Coast (Cont.)

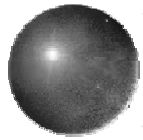
- ❏ Use interim ground infrastructure
- ❏ Free broadcast services
- ❏ Forward-compatible with avionics
- ❏ Siting based on user demographics
- ❏ Leverage technologies developed on SF21 Test bed
- ❏ Control facility and Test Bed at WJHTC
- ❏ IOC by end of FY 04



Gulf of Mexico

- ⊕ **Goal:** To apply and/or develop ADS-B, multilateration and related technologies to meet user needs in the enroute, off-shore, and oceanic environments with the end goal of NAS wide implementation
- ⊕ Three level approach
 - ⊞ Establish north/south high altitude ADS-B radar like services.
 - ⊞ Establish ADS-B services for helicopter traffic
 - ⊞ Establish terminal like services for helo traffic.





Summary

- ⊗ ADS-B is a new, cooperative surveillance technology for aircraft and other vehicles.
- ⊗ CDTI provides cockpit or vehicle based display of other ADS-B traffic in the area.
- ⊗ TIS-B provides enhanced traffic picture.
- ⊗ Ground based systems (FAA and Non-FAA) will be able to display ADS-B information.
- ⊗ ADS-B equipage is growing.
- ⊗ ADS-B infrastructure deployment an FAA HQ initiative.